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THE WHITE-TAILED DEER IN MISSOURI

BY

Earl L. Atwood, Jr ,

and

Dr. Julian A. Steyermark

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THE WHITE-TAILED DEER IN MISSOURI

(Preliminary Report)

by

Earl L. Atwood, Jr.,

and

Dr. Julian A. Steyermark

CLARK NATIONAL FOREST
U. S. Department of Agriculture

*Region 9 (North central region)
St. Louis, Mo.*

St. Louis, Missouri

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GENERAL CONTENTS

Page

The White-Tailed Deer of Missouri

Introduction

PART I

Areas Studied and Animals Observed	4 - 5
E. L. Atwood, Jr.	

PART II

Deer Foods Discussion	5 - 18
E. L. Atwood, Jr. and J. A. Steyermark	

PART III

Scope of Applicability of Deer Food Findings	19 - 22
E. L. Atwood, Jr. and J. A. Steyermark	

PART IV

Missouri's Deer Population	23 - 24
E. L. Atwood, Jr.	

PART V

Deer Management Problems in Missouri	25 - 28
E. L. Atwood, Jr.	

PART VI

Life History Notes	29 - 34
E. L. Atwood, Jr.	

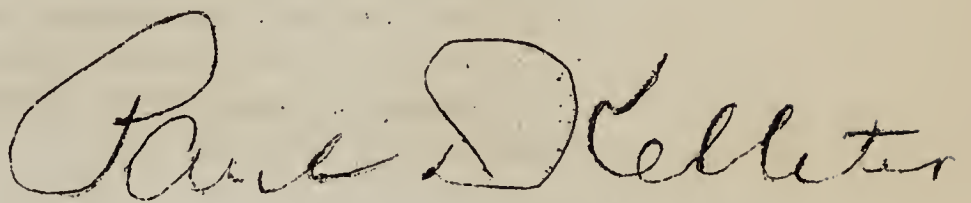
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FIGURES

- Figure 1. Forest and Prairie Areas of Missouri
(Taken from Northwestern Mutual Life
Ins. Company Map Timbered Areas and
Forest Types of Missouri)..... Facing page 20
- Figure 2. Ozark Area of Missouri (From map p. 401
Annotated Missouri Botanical Garden
Vol. 22).....Facing page 18
- Figure 3. Composite Map showing maximum possible
deer range..... Facing page 21
- Figure 5a Graphical Representation of Possible
Population Difference in Five Years
from an Annual Loss or Gain of Ten
Does..... Facing page 25
- Figure 5b Graphical Representation of Possible
Population in Five Years from an
Annual Loss or Gain of Five Does Facing page 25
- Figure 6. Graphical Representation of the Possible
Five Years Increase in Deer Population
by Saving Six and Eight Does Annually Facing page 23
- Figure 7. Graphical Representation of the Possible
Total Yearly Differences in Population
Over a Six Year Period, if an Annual
Loss of Three Does from Animal Predators
was Stopped..... Facing page 27
- Figure 8. Graphical Representation of the Possible
Total Yearly Gain in Deer Population if
the Annual Loss of Does was Reduced by
Twenty for Six Years..... Facing page 27
- Figure 9. Graph to show - Geometrical Progression
Type of Population Increase Over the
Same Period of Time by a Small Increase
of Annual Doe Savings..... Facing page 29

FOREWORD

The accompanying report is a preliminary study of the white-tailed deer of the Clark National Forest begun during 1935 and concluded in January 1937.

A handwritten signature in cursive script, reading "Paul D. Kelleter". The signature is written in dark ink and is positioned above the printed name and title.

PAUL D. KELLETER
Forest Supervisor

SOME PRELIMINARY OBSERVATIONS

on

THE WHITE-TAILED DEER IN MISSOURI

By

EARL L. ATWOOD, JR.

In charge of game management for the Clark National
Forest, U. S. Forest Service

and

DR. JULIAN A. STEYERMARK

Taxonomist and ecologist for the Clark National
Forest during the summer of 1936, and formerly Rufus
J. Lackland Research Fellow in the Henry Shaw School
of Botany, Washington University at the Missouri
Botanical Garden.

THE WHITE-TAILED DEER IN MISSOURI

by

Earl L. Atwood, Jr., and Dr. Julian A. Steyermark

INTRODUCTION:

Game management in the National Forests must be correlated with other forestry practices. If these practices are to be correlated intelligently for the mutual benefit of game and timber, it is necessary to know the plants valuable as game foods as well as those valuable as producers of timber.

Accordingly, in 1934 when "cultural" operations in the National Forest purchase units of Missouri were begun on a large scale using CCC labor, the foresters turned to those in charge of Fish and Game management for information. They wanted to know what plant species valuable to game should be given consideration.

At this time the phrase "Fish and Game Management" was foreign to most people in Missouri. No papers or bulletins on game food studies had been published for Missouri game. Published writings on game foods dwelt mainly on 'food patches', made up of domestic commercial species, and emergency winter feeding by artificial foods and methods. With the exception of quail, very little information was available on the natural foods of upland game, namely: deer, turkey, quail, cottontail rabbits, and squirrels.

For instance, of the twenty-one natural deer foods named by Townsend, Smith and Spiker in their "White-Tailed Deer of the Adirondacks" published in 1933, only six species, namely: maple, alder, birch, blackberry, bracken fern, and algae are found in the deer range of Missouri.

Game food lists supplied by Forest Service regional authorities were for the most part, inapplicable, since printed material applicable to Missouri conditions was not available. Thus, little information concerning natural game foods was available to those in charge of the "cultural" operations. The result was that adequate provisions for game food were not made.

With the realization that proper correlation of timber stand improvement practices and game management could not be worked out until more was known about natural upland game foods and game came

the desire for more information about them. But it was not until the fall of 1935 that accurate detailed studies could be initiated. At that time seven white-tailed fawns from Minnesota were made available for building up a breeding herd to help increase the badly depleted deer population of the Clark National Forest. The arrival of these deer gave the opportunity to make a detailed study of the natural foods and life history of white-tailed deer in Missouri.

A few months after the Missouri deer studies were initiated, a more comprehensive list of deer foods for Massachusetts by N. W. Hosely and R. K. Ziebarth became available. However, of the 90 foods listed by them as being taken by deer in Massachusetts (p. 548, Ecology Vol. XVI No. 4, October 1935), only 42 are found in the deer range of Missouri. Subsequent observations have shown that only 28 of these 42 are taken as food in Missouri, and of these 28 foods of the same genera only 17 are of the same species as those listed by Hosley and Ziebarth.

It will be noticed that the work on deer foods by Hosley and Ziebarth, Townsend, Smith and Spiker, and Maynard, Bump, Darrow and Woodward has all been in the Canadian and Alleghanian floral zones. Whereas, our work has been in the Carolinian floral zone, which includes some species of the more northern and more southern regions.

A comparison of the deer foods listed by the earlier workers and the Missouri deer foods listed in this paper indicates that the food of the white-tailed deer varies to a marked degree with each floral region and therefore, the results of an investigation in one region cannot be taken as representative for the entire range of a species if found in more than one floral zone, as is true of white-tailed deer. This and other facts brought out in other portions of the study emphasizes the value of deer studies in this floral region.

After these deer studies were initiated, a full time research man was detailed to Missouri by the Biological Survey, through the cooperative agreement between the Survey and the Forest Service. This assignment concerned itself with a study of the life history of the wild turkey. The preliminary report after a year's study on this problem has been published by the Biological Survey.

The information contained in these two reports will help fill the gaps in the lists of natural foods and in the life histories of our two most important upland game species.

The junior author became interested in the study of deer foods when called on in July 1936 for aid in classifying deer foods. As a taxonomist botanist, and as a result of his many years of study in the field, he has become one of the foremost authorities on the flora of Missouri. His studies of plant successions in the Ozark section of Missouri have familiarized him with the soil types and plant distribution of this area. Because of this experience he was

particularly well fitted for the scientific identification of the deer foods and for the general discussion on soil types and distribution of floral species.

Earl L. Atwood, Jr.

January 1937

PART I

AREAS STUDIED AND ANIMALS OBSERVED

To enable the reader to appreciate more fully the findings as listed in this paper, a short history of the animals and their management which has enabled these observations to be made is included here.

Late in the summer of 1935 (August 15) seven white-tailed fawns (three males and four females) were received from Minnesota. At this time all of the fawns were in the juvenile color phase and were quite tame. One of the female fawns continued to be bottle-fed for five weeks after arrival. No data on the exact ages of the fawns was obtained from the Minnesota authorities. However, a comparative study of the color phases, size, behavior and feeding characteristics at the time indicated the youngest to have been born about the middle of June. Another, nearly as small and bottle-fed for four weeks after arrival, was judged to have been born about June 1. Four others, all of the same size and with their spots not nearly as pronounced as the smaller two and weaned upon their arrival, were estimated to have been born in the first or second week of May. One buck fawn, notably larger than the others and considerably more advanced in juvenile coloration, was estimated to have been born the second or third week of April.

Lack of available funds at the time prevented the building of a holding pen by the Forest Service. Mr. Wm. Seever of St. Louis, very considerately offered the use of a 63-acre woven wire fenced tract in Reynolds County. This tract lies within the boundaries of the Clark National Forest. The cover types, topography and openings are typical of the Ozark area of Missouri.

In addition to the use of this tract of land, Mr. Seever offered the services of his caretaker, Mr. Henry Foltz. Since the arrival of the deer at the Seever area, Mr. Foltz has been with the deer constantly. He has spent most of every day and part of many nights with them. His keen daily observations have enabled the senior author to fill in gaps in observation and to list all data in their natural sequence of time and place.

Finally, in the summer of 1936, after a buck and two of the does were shot by local residents after escaping from the Seever enclosure, funds were made available for constructing a 90-acre eight foot woven wire enclosure within the Low Gap cooperative Forest Service State Game Refuge, located six miles east of the Seever tract and a few miles north of Centerville, Missouri.

In making the reconnaissance of the Low Gap refuge to find the most desirable area for locating the holding enclosure, an intensive survey of the flora of the understory was made for the purpose of

comparing the variety and quantity of the flora with that found on the Seever tract. The results of this survey indicated that from the standpoint of food alone, any of numerous areas studied would be satisfactory. This, and later distributional studies, substantiated the earlier conclusions that the observation areas were representative of much of the Ozark area of Missouri.

On September 1, 1936, the two does and two bucks remaining from the original seven fawns received from Minnesota were transported by means of a covered truck to the 90-acre enclosure inside the Low Gap refuge. At this time Mr. Foltz was employed by the Forest Service as caretaker for the entire Low Gap refuge. The responsibilities of his new position limited his available time for continuing his observations. However, he has continued to visit the holding area daily for at least an hour for this purpose as outlined for him.

The deer foods listed are the result of direct observation by the senior author, the junior author, and Mr. H. Foltz. The life history notes are the result of direct observations by the senior author and Mr. Foltz. The observations were made over a period of eighteen months beginning August 15, 1935 and ending January 15, 1937.

PART II

DEER FOODS DISCUSSION

The deer foods included in this paper have been listed under three main headings: Summer Foods, Winter Foods and Spring Foods. One subheading, Late Spring Foods, has been used in conjunction with the Spring Foods. These headings do not conform to the standard calendar conception of these seasons except in a general way and will therefore be defined for the Ozark section of Missouri as follows:

SUMMER FOODS:

The leafy foods produced during the period beginning with the attainment of full leaf development and ending with loss of leaves in the fall. Arbitrarily set as the period beginning with the last killing frost in the spring (April 3) and ending with the first killing frost in the fall (October 29).

WINTER FOODS:

The foods taken during the inactive resting period of trees, shrubs and most other plants. Arbitrarily set as beginning with the first killing frost in the fall (October 29) and ending with the swelling of the first buds and the appearance of green grass, usually about February 20 for the Ozarks of Missouri.

SPRING FOODS:

The foods taken during the transitional period beginning with

the swelling of the first buds in spring (usually about February 20 for the Ozarks of Missouri) and ending with the attainment of full foliage (arbitrarily set as the last killing frost in spring).

It is realized that even these rather loose definitions are not all-inclusive. Certain species overlap the dates given as marking the beginning and ending of each period. However, for our purpose of classification, the above defined seasons for the Ozark area of Missouri are more desirable than the standard calendar seasons.

The following lists include the botanical nomenclature in accord with present International Botanical Rules of Nomenclature. Each list is arranged by families according to the Engler-Prantl system.*

*The (G) is here used to indicate that the species is general or found throughout the Ozark region in its distribution.

The figures given in parentheses means the number of counties within the Ozark region in which this species occurs.

SPRING DEER FOODS

<u>Common Name</u>	<u>Botanical Name</u>	<u>Use</u>
<u>Non-flowering plants</u>		
Algae, pond scums	Spirogyra, Oedogonium, Vaucheria	entire
Mushrooms		
<u>Flowering plants</u>		
<u>Family GRAMINEAE</u>		
Muhly grass	Muhlenbergia Schreberi (G)	leaves
Panic grass	Panicum (various species)	leaves
Kentucky Blue grass	Poa pratensis (G)	leaves
<u>Family SALICACEAE</u>		
Black willow	Salix nigra (G)	buds
Ward's willow	Salix longipes var. Wardii (G)	buds
Sand-bar willow	Salix interior (G)	buds
<u>Family BETULACEAE</u>		
Hazel nut	Corylus americana (G)	buds
Alder	Alnus rugosa (40)	buds

<u>Common Name</u>	<u>Botanical Name</u>	<u>Use</u>
<u>Family FAGACEAE</u>		
White oak	Quercus alba (G)	buds
Black oak	Quercus velutina (G)	buds
Northern red oak	Quercus borealis, var. maxima (G)	buds

Family POLYGONACEAE

Smooth dock	Rumex altissimus (G)	leaves
Sour dock	Rumex crispus (G)	leaves
Broad-leaved dock	Rumex obtusifolius (G)	leaves
Swamp dock	Rumex verticillatus (G)	leaves

Family PAPAVERACEAE

Bloodroot	Sanguinaria canadensis (G)	leaves
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Family HAMMELIDACEAE

Ozark witch hazel	Hamamelis vernalis (29)	flowers & buds
Eastern witch hazel	Hamamelis virginiana (5)	buds & leaves

Family LEGUMINOSAE

White clover	Trifolium repens (G)	leaves
Red clover	Trifolium pratense (G)	leaves

Family ACERACEAE

Silver maple	Acer saccharinum (G)	flowers & leaves
Red maple	Acer rubrum (43)	flowers & leaves

Family BORRAGINACEAE

Blue bell	Mertensia virginica (G)	flowers & leaves
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LATE SPRING DEER FOODS

Family FAGACEAE

Oak sprouts	Quercus alba (G)	leaves
	" borealis var. maxima (G)	leaves
	" coccinea (19)	leaves
	" marilandica (G)	leaves
	" macrocarpa (G)	leaves
	" stellata (G)	leaves
	" velutina (G)	leaves

Family LEGUMINOSAE

Honey locust	Gleditsia triacanthos (G)	buds & leaves
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<u>Common Name</u>	<u>Botanical Name</u>	<u>Use</u>
<u>Family EBENACEAE</u>		
Persimmon	Diospyros virginiana (G)	buds & leaves
<u>Family OLEACEAE</u>		
White ash	Fraxinus americana (G)	
Green ash	Fraxinus pennsylvanica var. (G) lanceolata	buds & leaves
<u>Family COMPOSITAE</u>		
Dandelion	Taraxacum palustre var. (G) vulgare	leaves
<u>SUMMER DEER FOODS</u>		
<u>Family SAXIFRAGACEAE</u>		
Wild hydrangea	Hydrangea arborescens (G)	leaves
<u>Family HAMMELIDACEAE</u>		
Ozark witch hazel	Hamamelis vernalis (29)	leaves
<u>Family ROSACEAE</u>		
Red Haw, hawthorn	Crataegus (several species)	leaves
Dewberry, creeping blackberry	Rubus flagellaris (G)	leaves
Black raspberry	Rubus occidentalis (G)	leaves
Climbing rose	Rosa setigera var. tomentosa (G)	leaves
White avens, red root	Geum canadense var. camporum (G)	leaves
Cinquefoil	Potentilla simplex (G)	leaves
Wild strawberry	Fragaria virginiana var. (G) illinoensis	leaves
<u>Family LEGUMINOSAE</u>		
Sweet white clover	Melilotus alba (G)	leaves
Sweet yellow clover	Melilotus officinalis (G)	leaves
Hog peanut	Amphicarpa bracteata (G)	leaves
White clover	Trifolium repens (G)	leaves, flowers
Yellow hop clover	Trifolium procumbens (G)	leaves
Red clover	Trifolium pratense (G)	leaves, flowers
Tick trefoil	Desmodium acuminatum (G)	leaves
beggar's ticks	" bracteosum (G)	leaves
or beggar's lice	" canescens (G)	leaves
	" Dillenii (G)	leaves
	" laevigatum (14)	leaves
	" marilandicum (28)	leaves
	" nudiflorum (23)	leaves

<u>Common Name</u>	<u>Botanical Name</u>	<u>Use</u>
<u>Family ANACARDIACEAE</u>		
Poison ivy	Rhus toxicodendron (G)	leaves
<u>Family EUPHORBIACEAE</u>		
Hogwort	Croton capitatus (G)	leaves
Hogwort	Croton monsanthogynus (G)	leaves
<u>Family BALSAMINACEAE</u>		
Touch-me-not or Jewel weed	Impatiens biflora (G)	leaves, upper stem
<u>Family DIOSCOREACEAE</u>		
Ozark wild yam	Dioscorea quaternata (16)	leaves
<u>Family BETULACEAE</u>		
Hazelnut	Corylus americana (G)	leaves
Hop hornbeam or ironwood	Ostrya virginiana (G)	leaves
American hornbeam, blue beech, or ironwood	Carpinus caroliniana (G)	leaves
<u>Family JUGLANDACEAE</u>		
Black walnut	Juglans nigra (G)	sprouts
Shagbark hickory	Carya ovata (G)	young stem, leaves
Mockernut hickory	Carya tomentosa (G)	leaves of shoots
<u>Family FAGACEAE</u>		
White oak	Quercus alba and Q. alba f. latiloba (G)	leaves
Black oak	Quercus velutina (G)	leaves of shoots
Northern red oak	Quercus borealis var. maxima (G)	leaves
<u>Family ULMACEAE</u>		
American elm	Ulmus americana (G)	leaves
Winged elm, cork elm	Ulmus alata (G)	leaves
Slippery elm	Ulmus fulva (G)	leaves
<u>Family POLYGONACEAE</u>		
Wild buckwheat	Polygonum scandens (G)	leaves
Field sorrel, sheep sorrel	Rumex acetosella (G)	leaves
Smart weed, Water Pepper	Polygonum punctatum (G)	leaves, flowers
Lady's thumb	Polygonum pensylvanicum (G)	leaves, flowers

<u>Common Name</u>	<u>Botanical Name</u>	<u>Use</u>
<u>Family SCROPHULARIACEAE</u>		
Yellow false fox glove	Aureolaria flava var. (8) macrantha	leaves
<u>Family ACANTHACEAE</u>		
wild petunia	Ruellia pedunculata (28)	leaves
<u>Family PLANTAGINACEAE</u>		
Rugel's plantain	Plantago Rugelii (G)	leaves
<u>Family RUBIACEAE</u>		
Shining bed straw	Galium concinnum (G)	leaves, stem
<u>Family CAPRIFOLIACEAE</u>		
Coral berry, Buck brush	Symphoricarpos orbiculatus (G)	leaves
<u>Family CAMPANULACEAE</u>		
American bell flower	Campanula americana (G)	leaves
Blue lobelia	Lobelia siphilitica	leaves
<u>Family COMPOSITAE</u>		
Ox eye daisy	Chrysanthemum leucanthemum (G) var. pinnatifidum	leaves
Daisy fleabane	Erigeron philadelphicus (G)	leaves
Daisy fleabane	Erigeron annuus (G)	leaves
Boott's goldenrod	Solidago arguta var. Boottii (14)	upper leaves
Goldenrod	Solidago hispida (26)	leaves
Black-eyed Susan	Rudbeckia hirta (G)	basal leaves
Starry rosin weed	Silphium asteriscus (13)	leaves
Wild Aster	Aster sagittifolius (G)	leaves
Wild Aster	Aster anomalus (G)	leaves
Wild Aster	Aster lateriflorus (G)	leaves
Giant rag weed, Horse weed	Ambrosia trifida (G)	leaves
Wild lettuce	Lactuca canadensis (G)	leaves
Compass plant		
Hawkweed	Hieracium Gronovii (G)	leaves
Dandelion	Taraxacum palustre var. (G) vulgare	leaves, flowers

WINTER DEER FOODS

<u>Common Name</u>	<u>Botanical Name</u>	<u>Use</u>
<u>Non-Flowering Plants</u>		
Mushrooms	Family <u>AGARICACEAE</u> (G)	entire
	Family <u>POLYPODIACEAE</u>	
Christmas fern Winter fern	Polystichum acrostichoides (G)	leaves, stem
<u>Flowering Plants</u>		
	Family <u>GRAMINEAE</u>	
Muhly grass	Muhlenbergia Schreberi (G)	lower leaves,
Panic grasses	Panicum (various species) (G)	leaves, stem
Kentucky Blue grass	Poa pratensis (G)	leaves
	Family <u>CYPERACEAE</u>	
Sedge	Carex umbellata (G)	leaves
	Family <u>JUNCACEAE</u>	
Rush	Juncus macer (G)	leaves
	Family <u>SALICACEAE</u>	
Black willow	Salix nigra (G)	buds, twigs
Ward's willow	Salix longipes var. Wardii (G)	buds, twigs
Sand-bar willow	Salix interior (G)	buds, twigs
	Family <u>BETULACEAE</u>	
Hazelnut bush	Corylus americana (G)	catkins, buds, twigs
Ironwood, Hop hornbeam	Ostrya virginiana (G)	catkins, buds, twigs
Blue beech, American hornbeam	Carpinus caroliniana (G)	catkins, buds, twigs
Alder	Alnus rugosa (G)	catkins, buds, twigs
	Family <u>JUGLANDACEAE</u>	
Shagbark hickory	Carya ovata (G)	buds of reprod.
Mockernut hickory	Carya tomentosa (G)	buds of reprod.
Butternut, white walnut	Juglans cinerea (G)	bark, buds, twigs of reprod.

<u>Common Name</u>	<u>Botanical Name</u>	<u>Use</u>
<u>Family FAGACEAE</u>		
Oak acorns	Quercus alba and Q. alba f. latiloba (G)	entire nut
	Quercus borealis var. maxima (G)	entire nut
	Quercus coccinea (19)	cured leaves, nut
	Quercus marilandica (G)	entire nut
	Quercus stellata (G)	entire nut
	Quercus velutina (G)	entire nut
<u>Family ULMACEAE</u>		
Slippery elm	Ulmus fulva (G)	buds, twigs of reprod.
American elm	Ulmus americana (G)	buds, twigs of reprod.
Winged elm	Ulmus alata (G)	buds, twigs of reprod.
Cork elm		
<u>Family POLYGONACEAE</u>		
Field sorrel	Rumex Acetosella (G)	leaves
<u>Family CARYOPHYLLACEAE</u>		
Mouse-eared chickweed	Cerastium vulgatum var. hirsutum (G)	leaves
Mouse-eared chickweed	Cerastium brachypodum (G)	leaves
Fire pink	Silene virginica (27)	leaves.
<u>Family CRUCIFERAE</u>		
Water cress	Roripa Nasturtium-aquaticum (G)	leaves, stem
<u>Family LAURACEAE</u>		
Sassafras	Sassafras albidum var. molle (G)	buds, twigs
<u>Family SAXIFRAGACEAE</u>		
Alum root	Heuchera hirsuticaulis (15)	leaves
<u>Family ROSACEAE</u>		
Cinquefoil, five-fingers	Potentilla simplex (G)	leaves
Hawthorn, Red haw	Crataegus (various species) (G)	buds
Wild rose	Rosa carolina (G)	leaves
Wild rose	Rosa subserulata (G)	leaves
Blackberry	Rubus ostryifolius (G)	leaves
Dewberry, creeping blackberry	Rubus flagellaris (G)	leaves
Black raspberry	Rubus occidentalis (G)	leaves
Apple	Malus pumila (Scattered)	buds, twigs
Serviceberry	Amelanchier canadensis (G)	buds, twigs

<u>Common Name</u>	<u>Botanical Name</u>	<u>Use</u>
<u>Family LEGUMINOSAE</u>		
Clover	Trifolium repens (G)	dried leaves, stem
Clover	Trifolium pratense (G)	dried leaves, stem
<u>Family ANACARDIACEAE</u>		
Fragrant sumac	Rhus canadensis (G)	buds, twigs
Dwarf staghorn sumac, winged sumac	Rhus copallina (G)	stem
Smooth staghorn sumac	Rhus glabra (G)	stem
<u>Family ACERACEAE</u>		
Sugar maple	Acer saccharum (G)	buds, twigs of reprod.
Silver maple	Acer saccharinum (G)	buds, twigs of reprod.
Red maple	Acer rubrum (43)	buds, twigs of reprod.
<u>Family HYPERICACEAE</u>		
St. Andrew's cross	Ascyrum hypericoides (G)	leaves
<u>Family CORNACEAE</u>		
Flowering dogwood	Cornus florida (G)	buds, twigs
<u>Family ERICACEAE</u>		
Highbush huckleberry	Vaccinium stamineum (25)	buds, twigs
Highbush huckleberry	Vaccinium stamineum var. neglectum (25)	buds, twigs
Lowbush huckleberry	Vaccinium vacillans var. crinitum (25)	buds, twigs
<u>Family PRIMULACEAE</u>		
Water Pimpernel	Samolus parviflorus (G)	leaves
<u>Family POLEMONIACEAE</u>		
Phlox, Sweet William	Phlox pilosa var. virens (G)	top leaves, stem
<u>Family PLANTAGINACEAE</u>		
Plantain	Plantago virginica (G)	leaves of young plants
<u>Family COMPOSITAE</u>		
Pussytoes, Ladies tobacco	Antennaria plantaginifolia (G)	leaves
Sweet everlasting	Gnaphalium obtusifolium (G)	leaves
Aster	Aster anomalous (G)	basal leaves
Aster	Aster laevis (G)	basal leaves
Field goldenrod	Solidago nemoralis (G)	basal leaves
Gray goldenrod		

FEEDING TECHNIQUE:

A glance at the deer food lists which are by no means yet complete indicates the wide variety of foods taken by white-tailed deer in the Missouri Ozarks.

Observations on feeding deer show them to be moving browsers. They seldom stop for more than a second to browse at any one spot. They are very dainty in their feeding - a bud or two from an alder, a few blades of panic grass, or a single leaf from an aster plant. A very close examination of the plant in question is necessary to disclose where it has been browsed upon. Observations disclosed that usually only the most tender or succulent part of each plant was nibbled.

An important and rather remarkable point brought out in these observations is the wide daily variety of foods, even during the winter and spring periods. During each period some plant species would be taken one day and passed up the next only to be taken again on the third day. Some foods were taken more often than others and seemingly were more sought after.

Variations in climatological conditions had a marked effect in changing the daily foods. In winter a rainy period followed by a few warm sunny days resulted in more green grass-like plants and rosettes of green basal leaves of flowering plants. While this green material was available the deer browsed more heavily on it than on the buds and twigs of the shrubs and trees. With but a few exceptions the deer sought out the most succulent foods which occurred at the time.

In comparing the food observations with those made during the Willsboro Experiments carried on in New York State in a cooperative study by the New York State Conservation Department and the New York State College of Agriculture, and the natural foods listed by Townsend, Smith and Spiker in their study of the "White-tailed Deer of the Adirondacks," our findings substantiated those of these earlier workers for the species listed by them which also occurred on the Missouri observational areas with the exception of a few rather important species among which are the following:

Bracken (*Pteris aquilina*) As given in list by Townsend, Smith and Spiker*

Though one variety of the bracken (*Pteridium latiusculum* var. *pseudo-caudatum*) is found in the observational area, at no time were the deer observed feeding on it.

*It is now generally recognized that the common bracken fern of eastern U.S. should be known as *Pteridium latiusculum*, rather than its previously used name, *Pteris aquilina*, now conceded to be a common old world species. Both *Pteridium latiusculum* and var. *pseudocaudatum* are found in the Ozark region.

Red Cedar (Juniperus virginiana)

Though this tree grew on the observational area, it was represented to only the juvenile stage of the tree, the foliage of which is made up of sharper needles than that of the mature trees. At no time during the observations did the deer browse on the red cedar.

Rock Mosses:

This term is used rather loosely and may be applied to such diverse groups as true mosses, including species of Sedum, Talinum, etc. It is assumed, however, that these authors included their use of the term to designate true mosses. At no time were any true mosses eaten by the deer in Missouri during the observations and no evidences were found that they were taken.

SPRING FEEDING:

In general, deer browsed on the buds, flowers and young leaves as these various portions of the plants became available.

The maples, elms, hickories, sassafras, dogwoods, witch hazels, alders, hazelnuts and willows bloom early and were taken successively as they budded and blossomed. The mushrooms, algae, hickories, maples, hazels, dogwoods, witch hazels, willows, clovers and grasses, bluebell, bloodroot and docks seemingly were preferred in the order named over other listed foods occurring at the same time. However, except for the mushroom and algae these preferences were not sharply evident and changed as the season advanced. It was found that as the oaks sprouted, they were eagerly sought after as were the persimmon, the ashes, honey locust and dandelion.

During the course of feeding all or nearly all of the listed foods which have sprouted at the time will be taken. As the season advanced and more species sprouted the daily diet became more varied as to species but was made up for the most part of young leaves.

SUMMER FEEDING:

As the season advanced and herbaceous plants made their appearance, the deer diet changed from one made up principally of leaves of seedlings and sprouts of trees and shrubs to a diet principally of herbaceous plants. Thus for instance, during early July, of 73 foods observed as being taken in one day, only 9 were tree leaves, 5 shrub leaves and 2 vine leaves. By this time the grasses and grass-like plants as the sedges and rushes had become too tough to be taken while the herbaceous growth which was available in large numbers made up the remainder of the diet.

At this time, of the great number of herbaceous plants which occurred, few common ones were not taken at all. Among these were the ironwoods (Vernonia), bitterweed (Helenium), mugwort (Artemisia vulgaris var. ludoviciana), and the ragweeds (Ambrosia artemisiaefolia

OSARK AREA
OF
MISSOURI

SCALE IN MILES
0 10 20 30 40 50

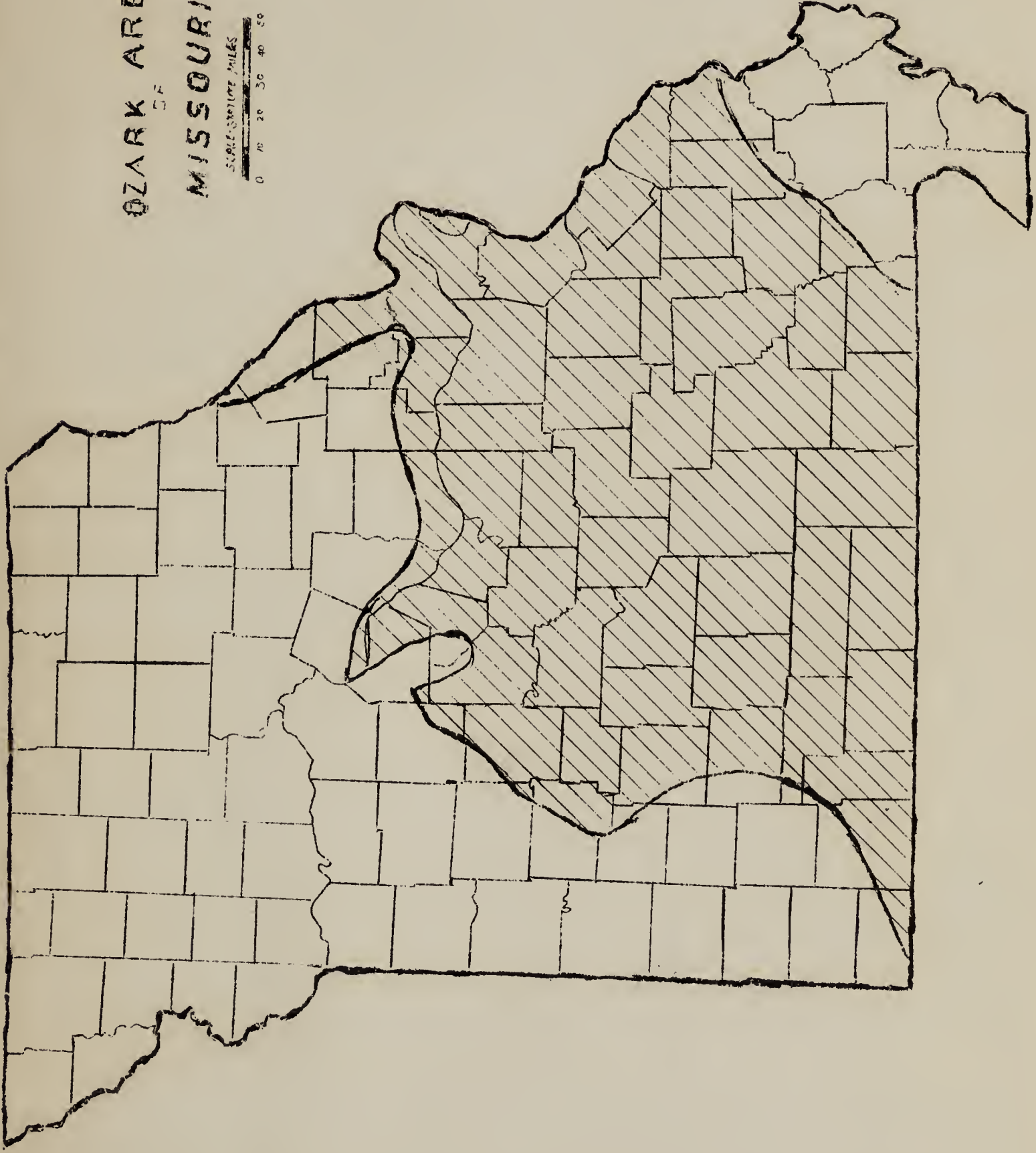
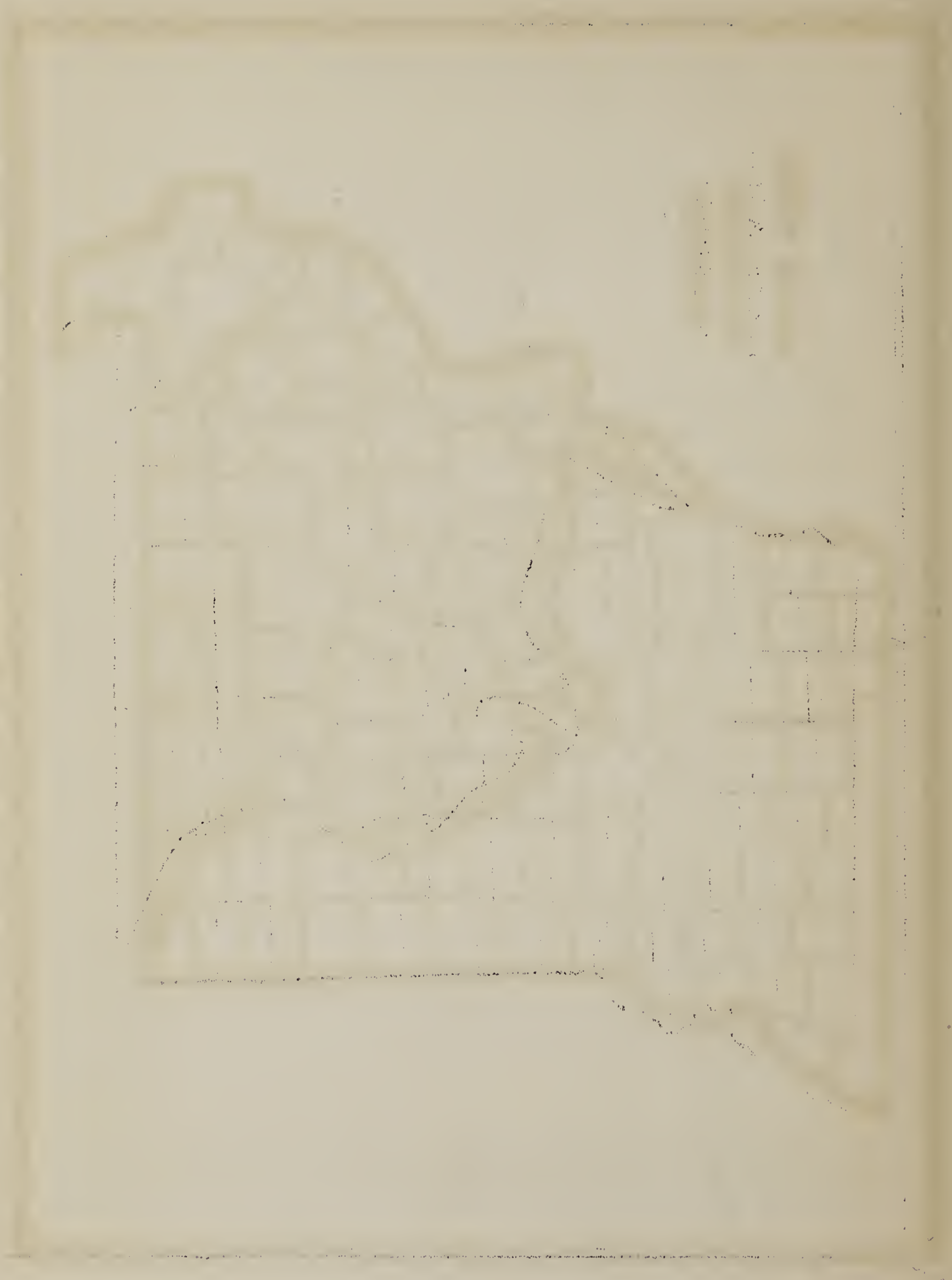


Figure 2



var. *elaticus* and var. *elaticus* f. *villosa*). However, occasional leaves from the giant ragweed or horseweed (*Ambrosia trifida*) were taken at this time. The mints were another group that were not taken, with the exception of self-heal (*Prunella vulgaris* var. *lanceolata*). These plants all contain unpleasant odors, oils, and flavors which are probably distasteful to deer. With the exception of these plants and those which by mid-summer are tough, wiry, or contain an abundance of short stiff hairs or prickles, the observations have brought the conclusion that the leaves of most of the herbs, vines, shrubs and a few of the tree leaves such as the hickories, white oak, black oak, hawthorn, flowering dogwoods, black walnut, and ironwood are taken during the summer.

By late summer as the seeds of the herbaceous species matured, the stems and leaves became hard and dried. By late September the diet shifted to a preponderance of vine, shrub and tree leaves. Some preference was shown for the leaves and tendrils of the grape vine, fragrant sumac, hawthorn, ironwood, American hornbeam (bluebeech), and hazel nut leaves. Besides these, those foods listed under the POLYGONACEAE, ROSACEAE, LEGUMINOSAE and COMPOSITAE families continued to make up an appreciable portion of the deer's diet.

WINTER FEEDING:

With the coming of the heavy frosts most of the leaves were killed. As this occurred, the deer began feeding on the pussytoes, cinquefoil, dogwood and alder buds. However, the frosts also brought down the acorns and though the above mentioned foods were taken in quantity, the acorn became the most important food. No preference for any particular species of oak was shown. The entire nut with the exception of the cup was hunted after and eagerly taken, even though the nut was partially decayed.

An almost immediate response to this new element of the diet was evidenced by increased weight. That the acorn has high nutrient properties was clearly evident at a glance. Though the deer were in very good condition before acorns formed their chief diet, the change after a few weeks on the new diet was almost as marked as is the change in appearance of the free range hogs in the fall in a good acorn year. The acorns were eaten as long as they were available, which was until about the first week in January. However, by December 15 the supply was depleted to the point where the deer began supplementing the acorns with buds of serviceberry, alder, hazelnut, eastern witch hazel, blackberry leaves, cinquefoil and pussytoes.

By the end of December they were taking the leaves of the winter fern, basal leaves of *Aster anomelus*, Kentucky blue grass, field sorrel, plantain, chickweeds, fire pink, alum root, muhly grass, sedge (*Carex umbellata*), rush (*Juncus macer*), water pimpernel, phlox, sweet everlasting, goldenrod, St. Andrew's cross, mushrooms and water cress. Later on the buds and twigs of the Ozark witch hazel, elms, sassafras,

maples, dogwoods, huckleberry, butternut, hickories, and willows, and the leaves of the wild rose, blackberry, and black raspberry, which remain green until some time in February or later, are taken.

Still later, in addition to the buds and twigs of the species named the deer take the stems of the staghorn sumacs, dried clover, winter fern and pussytoes. About this time the buds of the early shrubs and trees begin to swell and are the more preferred foods. The early spring foods are by this time available.

SCOPE OF APPLICABILITY OF DEER FOOD FINDINGS

To indicate the wide-spread significance and applicability of the deer food findings listed in this paper it is necessary to tie in the distribution of the flora represented in the observational areas. But before this is done, it is important to indicate the maximum limits of the possible deer range insofar as cover is concerned. One of the prime requisites of deer range is cover. With this in mind, consult map, Fig. 1, which shows the timbered and prairie areas of the state. A glance at this map shows immediately that the prairie areas comprise, roughly, 40% of the area of the state and which can at once be eliminated from further consideration. Now let us consider the timbered area of the state. The largest part of this area comprises the Ozark section of Missouri, Fig. 2. Because of the rugged topography and general low fertility of the land as compared with the other portions of the state, this area is still quite generally covered with second growth timber and undergrowth which is good deer cover.

The timber outside of the Ozarks along the northern edge is for the most part of the wood-lot type. Since the region north of this edge is so predominately made up of the prairie flora, the limited number of more extensive forested areas in this part of the state are too much surrounded or interrupted by extensive open areas that deer cannot find adequate continuous forested areas for a complete habitat. Therefore, this area is not included in the maximum limits of the possible deer range.

On the other hand, however, there are numerous areas of open stretches within the Ozarks. These are particularly evident on the bald knobs and barrens in the White River region of the southwestern Ozarks. However, these glades are relatively narrow, necessitating only short distances of open travel between continuous forest cover and therefore are not a serious drawback. The Ozark region is predominately a forested one so that even though tracts of open land occur, the region in general is adequate from the standpoint of cover.

The other timbered area outside of the Ozarks not thus far discussed is the Southeastern Lowland Region. This area represents but 11% of the area of the state; and all land not in the swampy or frequently inundated areas is rather intensely farmed resulting in a high population density. The effect of the widely dispersed agriculture lands is to break up, with a few exceptions, the timbered areas into tracts of small size not suitable for deer range. For this reason the Lowland Region is also excluded from consideration as possible deer range.

A composite map made by superimposing the timber-prairie type map on the Ozark map, as taken from Palmer & Steyermark Annotated Catalogue of the Flowering Plants of Missouri, gives a rough idea of the maximum limit of adequate deer cover, Fig. 3. After deducting the areas of the three large artificial lakes, this amounts to approximately 30,500 square miles or, expressed in acres, 19,500,000 or, roughly, 44% of the area of the state.

As a result of the previous discussion, it has been brought out

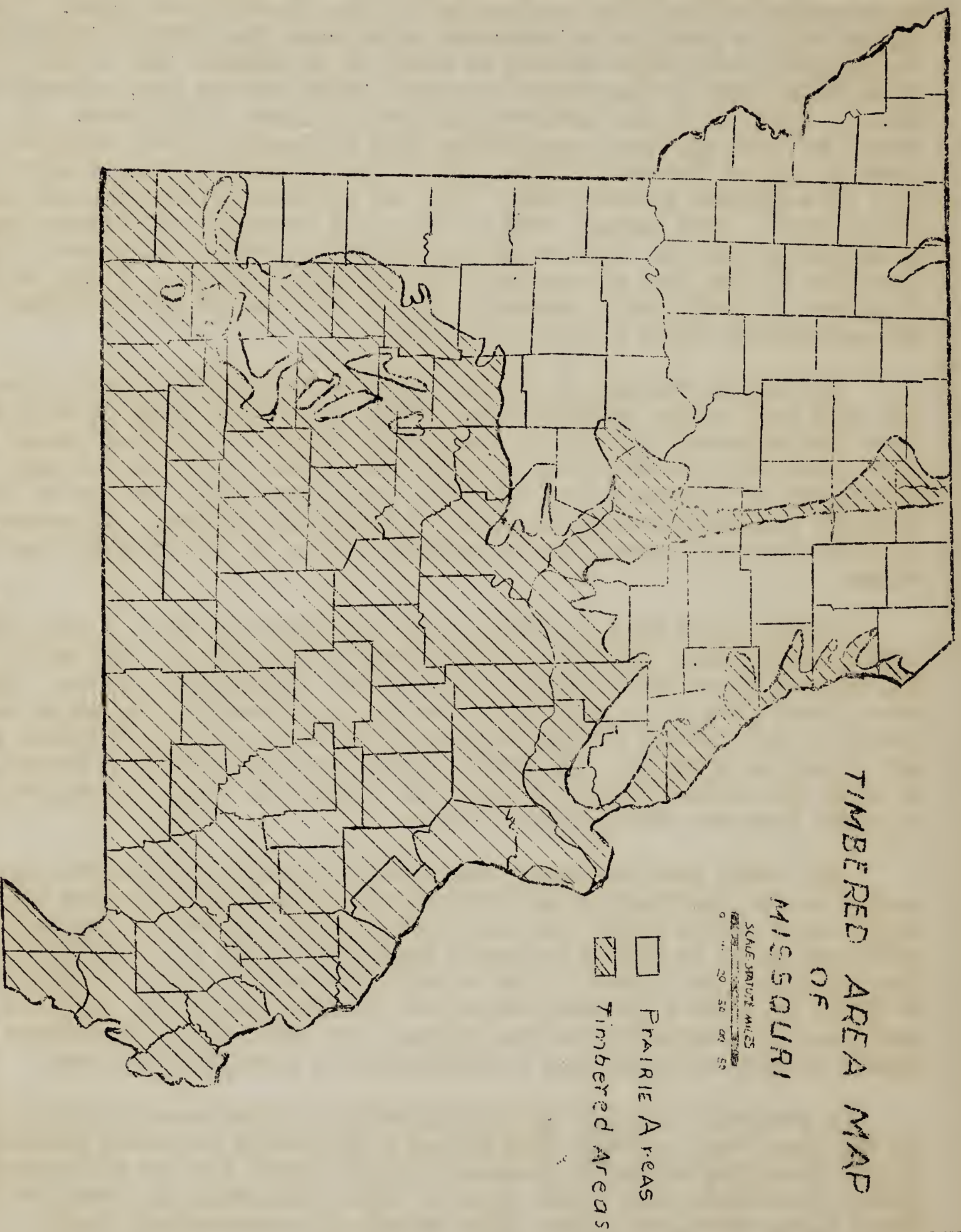


Figure 1

that the maximum limits of possible deer range in Missouri is limited to the Ozark region shown in the shaded portion of Fig. 3.

With this in mind, the widespread applicability for Missouri of the observations made on the observation areas can be easily shown. Of the 134 species listed, 117 or 87% are of general distribution over the entire Ozark region. Only 17 or 13% are of limited distribution and of those 9 are found in 25 to 45 of the 60 counties in the Ozark region, and 8 are found in 5 to 19 of the 60 counties.

Those foods of limited distribution are listed below:

<u>COMMON NAME</u>	<u>BOTANICAL NAME</u>
Scarlet oak	<i>Quercus coccinea</i>
Red maple	<i>Acer rubrum</i>
Tick trefoil	<i>Desmodium marilandicum</i>
Tick trefoil	<i>Desmodium nudiflorum</i>
Tick trefoil	<i>Desmodium laevigatum</i>
High bush huckleberry	<i>Vaccinium stamineum</i>
High bush huckleberry	<i>Vaccinium stamineum</i> var. <i>neglectum</i>
Goldenrod	<i>Solidago arguta</i> var. <i>Boottii</i>
Goldenrod	<i>Solidago hispida</i>
Wild petunia	<i>Ruellia pedunculata</i>
Ozark wild yam	<i>Dioscorea quaternata</i>
Alum root	<i>Heuchera hirsuticaulis</i>
Yellow false fox glove	<i>Aureolaria flava</i> var. <i>macrantha</i>
Fire pink	<i>Silene virginica</i>
Starry rosin weed	<i>Silphium asteriscus</i>
Ozark witch hazel	<i>Hamamelis vernalis</i>
Eastern witch hazel	<i>Hamamelis virginiana</i>

Each of the above listed species will now be discussed and evaluated as a possible limiting factor in reducing the deer range to less than the general Ozark area.

Scarlet Oak:

Though the distribution of this species is limited to the southeastern half of the Ozarks it is only one of seven oaks observed as being used by the deer. The other six oaks are of general distribution, and therefore, it seems logical to conclude that the scarlet oak is not a limiting species.

Red Maple:

Though there are small areas along the northern and western borders and in the extreme southwestern area of the Ozarks where this maple is absent, it is found in over 75% of the Ozark area. Two other maples are general throughout the entire Ozarks. This fact leads to the conclusion that this species is not a limiting factor.

Tick Trefoils (*Desmodium marilandicum*, *nudiflorum* and *laevigatum*)

Singly these species which were taken by the deer are of rather limited distribution, but taken together they have a much more general distribution throughout the Ozarks. Again their limited distribution are not limiting factors.

High bush Huckleberry (*Vaccinium stamineum* and var. *neglectum*)

These varieties are limited to the southern half of the Ozarks. However, the Low bush Huckleberry observed as being used by the deer is of general distribution in the Ozarks. Since from our observations the huckleberry did not appear to be a preferred food, it is very doubtful if the less than general distribution of the high bush varieties would limit the range.

Goldenrod (*Solidago arguta* var. *Boottii* and *Solidago hispida*)

As with the Tick trefoils of limited distribution in the Ozarks, these goldenrods taken singly are of more limited distribution, but taken together are of quite general distribution in the Ozarks. However, *Solidago nemoralis*, also browsed by the deer, is of general distribution. Again the two species of limited distribution are not limiting factors.

Wild Petunia (*Ruellia pedunculata*)

Though this species is not found in the most northern and western counties of the Ozark region, there are two other species of wild petunia found in the Ozark region, one of which is general. These species did not occur in the observational areas and may not be taken by deer. However, as this is only one of the more than forty herbaceous plants identified as being deer foods, its absence is probably not a limiting factor.

Ozark Wild Yam:

Though this species is limited to the southeastern Ozark region, the common yam (*Dioscorea villosa*) is quite common over the entire Ozarks and is probably eaten along with the other type. However, it was not found in the observational areas and its use is therefore not a certainty.

Alum Root (*Heuchera hirsuticaulis*)

This species, as with the Ozark wild yam, is limited to the southeastern Ozarks, but is only one of several species occurring in the Ozarks. It is probable that the widespread species (*Heuchera Richardsonii* var. *Grayana*) is eaten by deer.

Yellow False Fox Glove (*Aureolaria flava* var. *macrantha*)

This species is limited to the eastern Ozarks. However, another

COMPOSITE MAP

1870

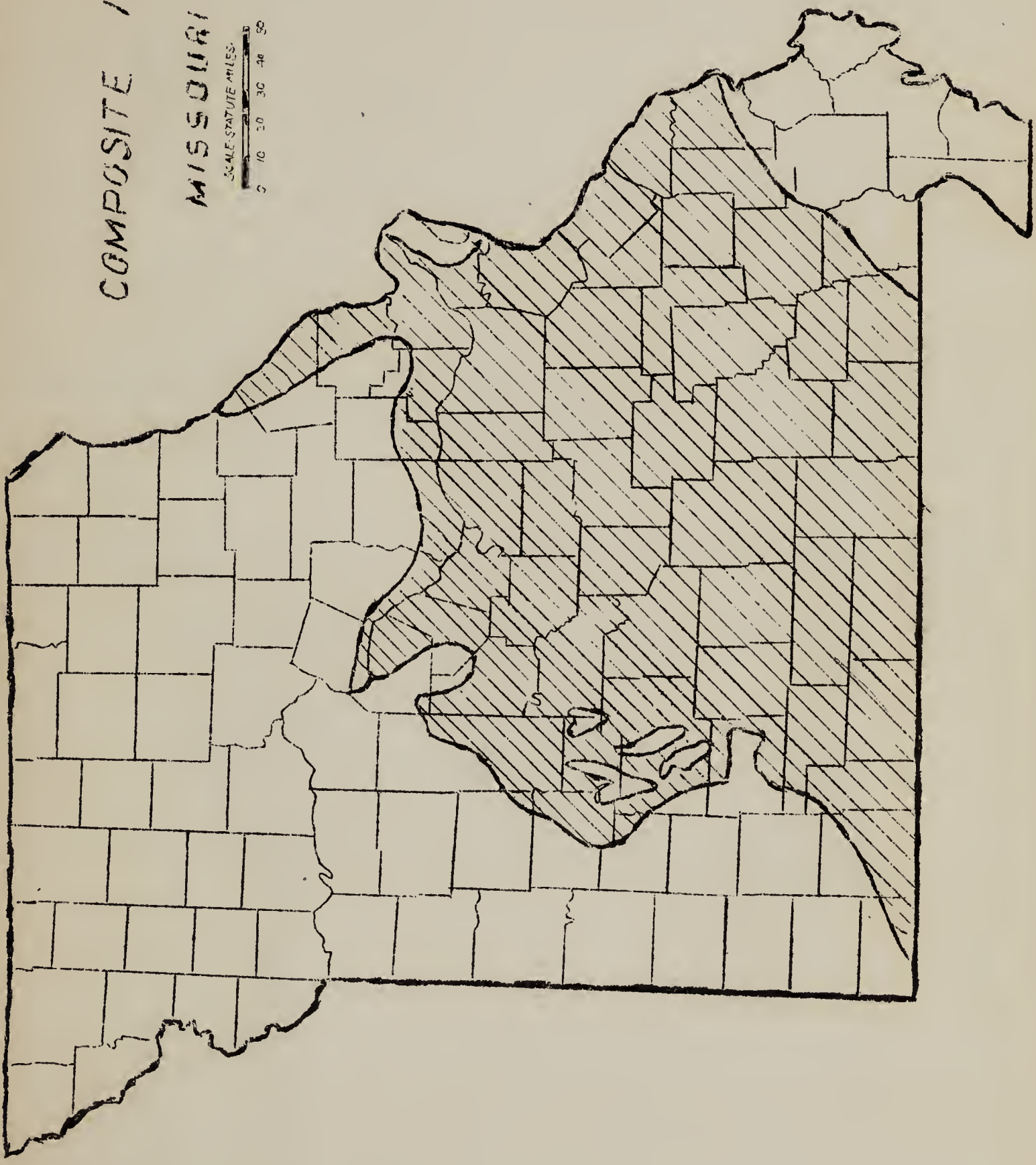
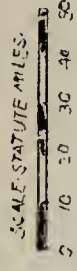
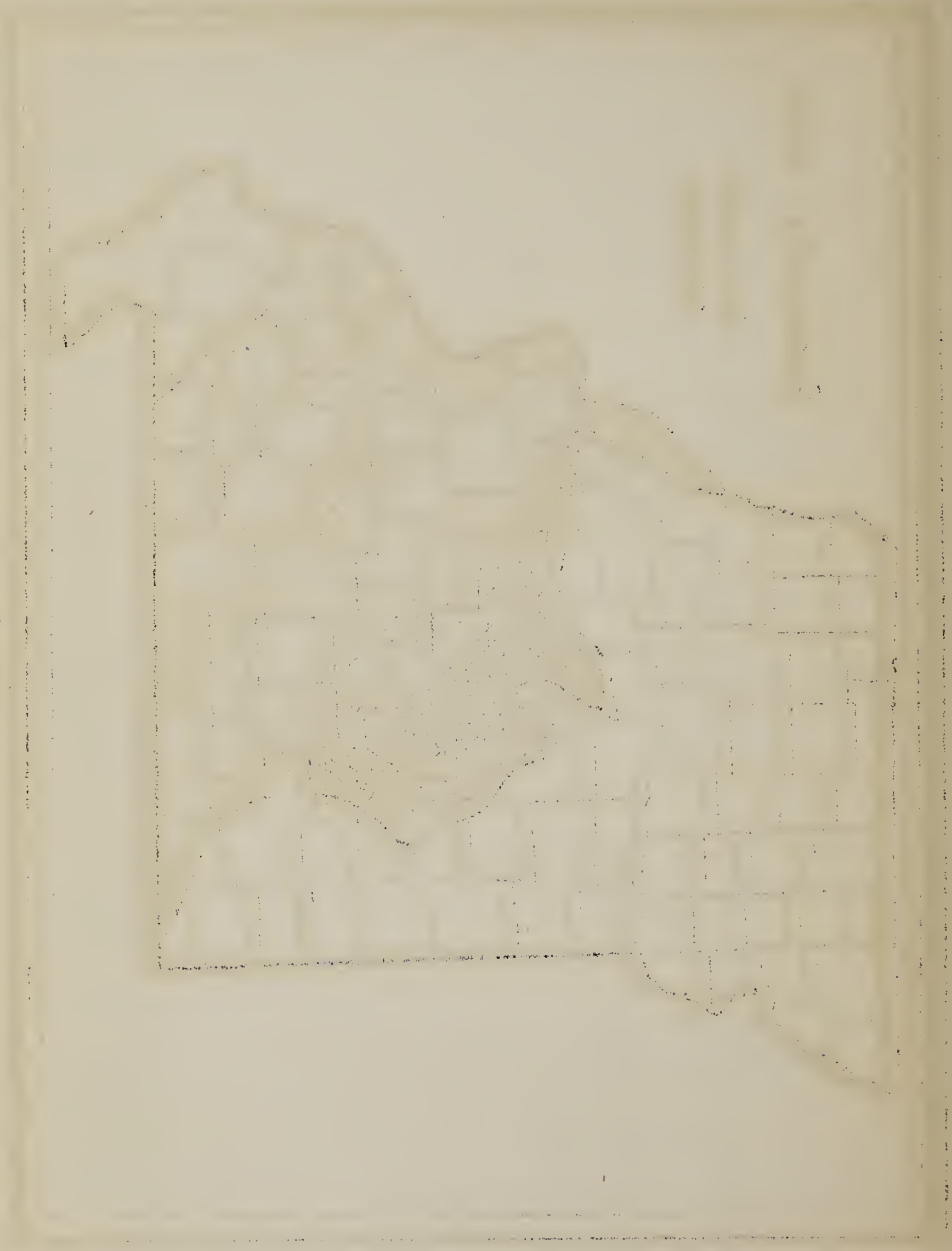


Figure 3



species of false fox glove (*Aureolaria calycosa*) is found in the southern Ozarks which closely resembles this species. Another species of slightly more pubescent growth (*Aureolaria grandiflora* var. *cinerea*) is general in the Ozarks. It is probable that one or both of these is taken by deer.

Fire Pink:

This species is limited to the southern and southeastern Ozarks.

Starry Rosin Weed:

This species is limited to the southern Ozark region.

The last two listed above are not of the preferred foods. Their absence among the forty-odd herbaceous plants will not be a limiting factor.

Witch Hazel:

The eastern witch hazel is of rather limited distribution though the Ozark species is general except along the eastern, northern and western edges of the Ozarks. Though this food is taken readily, there are many other foods of this type available which are of general distribution. Therefore, we concluded that this food is not a limiting factor.

In conclusion to the above discussion, several important points may be listed:

1. That nearly all of the observed deer foods are of general distribution in the Ozarks.
2. That related species of general occurrence are probably eaten by deer where observation showed a species of limited distribution served as food.
3. That the entire Ozark region, on the basis of food and cover, marks the maximum deer range in Missouri.

PART IV

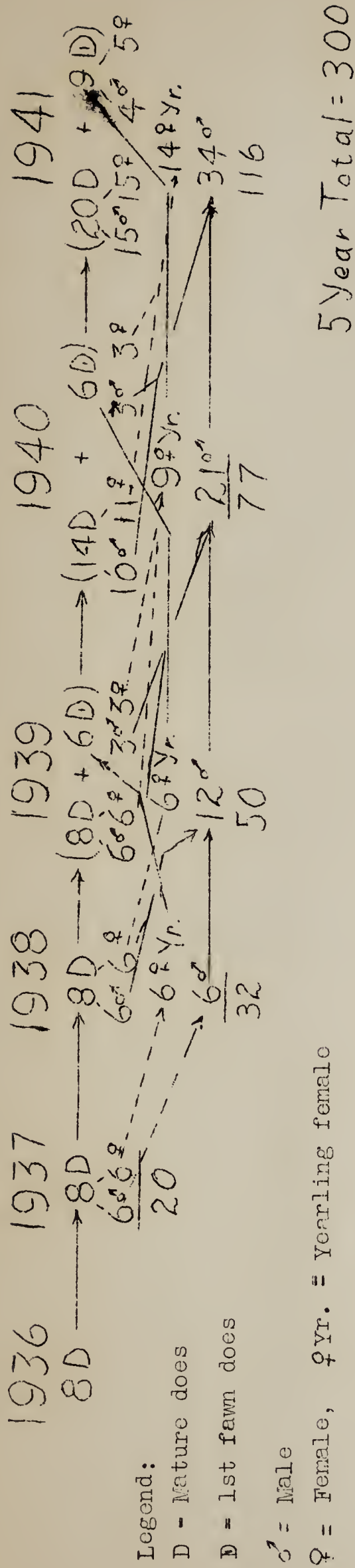
MISSOURI'S DEER POPULATION

The reader, if he be aware of the alarmingly depleted deer population in Missouri, may begin to wonder at this point, how it happens that with an adequate cover and a bountiful food supply in the Ozarks, we have such a sadly depleted deer population.

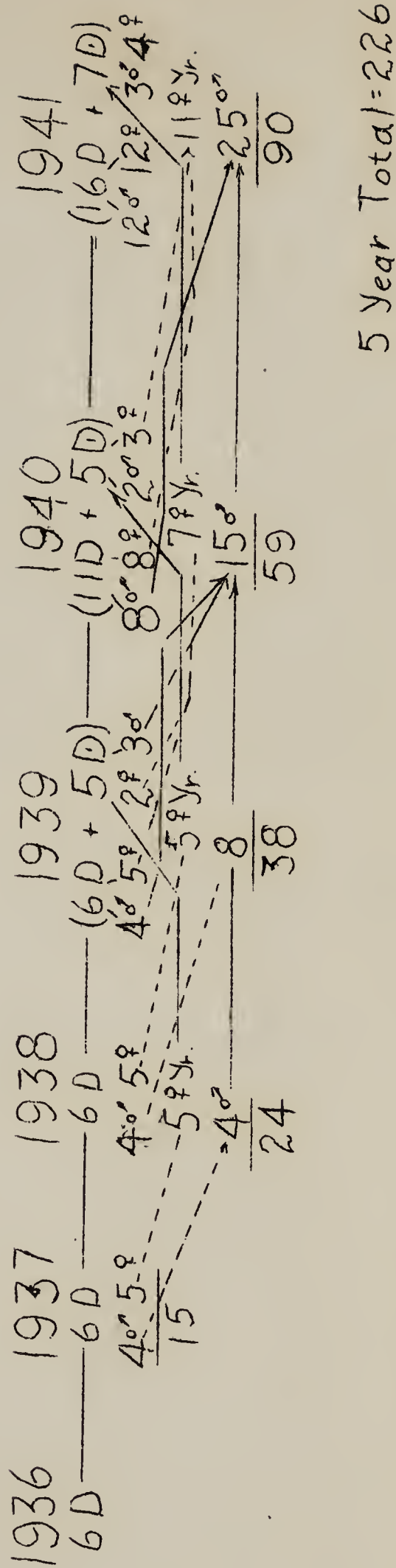
For these readers who are not aware of the precariousness of the deer population at the present time in Missouri, it will be enlightening to learn of the results of an extensive survey of the Clark National Forest. The survey was conducted by the Fish and Game Assistant in which actual field studies were combined with contacts of reliable rural residents in each community for the purpose of accurately determining the extent of the present deer range. The results of this survey may well fill the conservationist with dismay, for out of the 1,970,000 acres within the boundaries of the Clark Forest only approximately 290,000 acres were being used by deer this year. This represents less than 15% of the total land area within the boundaries of the Clark National Forest.

To determine the approximate number of deer within the deer range three deer drives were made in widely separated areas. The acreage over which the drives were made varied from approximately two to three square miles, and was determined accurately. Observers and drivers surrounded the areas to be driven, and were stationed so that they could observe any game animal which passed between them. Tallying was limited to game observed to the right of each man to prevent duplications. The results of the drives were averaged and reduced to a deer per section figure. This figure was applied to the previously determined deer range to express the deer population. The final results showed a population for the Clark Forest of 370 deer.

This method of determining deer populations may be subject to rather wide errors if representative areas are not picked for sampling. However, because of the extreme low population densities the tendency in choosing the areas to be censused is to pick the better than average areas. This results from the natural tendency to choose concentration areas which deer are known to be using so that the results obtained are too high. Just how much this final figure is in error is questionable. However, some check as to the accuracy of this method was needed. Therefore, an area with a range of approximately 40,000 acres which was well known to game men was censused by the sampling method which indicated a population of 65 deer for this range. Later this same area was subjected to an intensive check survey and a population of 58 deer was found. On the assumption that the second method yielded the correct population figure, since the game assistants making the check survey were old hunters for many years familiar with that deer range, the sampling method was in error 12%. If we assume that the average of the two population figures more nearly represents the true population, we find the sample method in error only 5%.



Possible Five-Year Increase in Deer Population by Saving Eight Does Annually



Possible Five-Year Increase in Deer Population by Saving Six Does Annually

Figure 6

Therefore, by taking 95% of the total of 370 deer arrived at by the sampling method for the deer population of the Clark Forest or 352 deer, this figure is as near the actual population as can be determined by any applicable method of taking a deer census.

The deer range of the Clark Forest represents approximately 55% of the present deer range of the state. Assuming that the deer range of the Clark Forest is representative of the entire range and that the intensities of population in the remainder of the state are the same as those in the Clark Forest, an estimate of the population for the state is possible. By this method the population for the state is estimated at 640 deer for 1936 prior to the hunting season. The State Fish and Game Department reported a total kill of 82 legal bucks for 1936. In addition to this loss, authentic reports show the loss by illegal shooting of eight deer, the loss of one buck by dogs chasing it over a cliff, and the loss of two deer by wolves. These losses occurred within an area constituting 60% of the deer range of the state. It is reasonable to suppose that losses in the remainder of the state are of the same magnitude, since the warden districts of the State Fish and Game Department, responsible for administering the game laws, are of approximately the same size in the Ozark section of the state. On the basis of our reports of illegal kills by illegal shooting, the loss for the state would be 15, of which 10 were does. The loss to the state from predators on the basis of extending the report to the entire state would be six, of which three would be does.

Thus, at the end of the hunting season the 640 deer would be reduced by 82 legal bucks, 15 illegal kills and 6 killed by predators so that only 537 remain. It is realized that the figures quoted may not be exact, but they are relatively correct.

The reticence of the residents of the Ozarks to give full information of the number of deer killed illegally definitely limits the accuracy of the information obtained.

PART V

DEER MANAGEMENT PROBLEMS IN MISSOURI

The size of a game population on a given area is dependent upon certain variables each of which acts to increase or decrease the size of population. Among these factors are (1) Cover, (2) Food, (3) Climate, (4) Predators, (5) Disease, (6) Hunting.

The first two factors, namely food and cover have been studied in detail and treated in detail in a previous discussion. The food and cover factors are positive rather than limiting factors in the deer problem. Climate is a positive factor. Intense cold, deep snow necessitating deer yarding is a climatological problem of areas other than in Missouri.

Disease:

During the last fifteen years only one serious loss from disease has occurred. In 1935 about a dozen deer carcasses were found in and near the Indian Trail State Park. Examination of the carcasses showed that death had resulted from disease. At this time eighteen deer are known to have died from disease at Deer Run State Park. This loss, though serious at the time because of the low deer population is not a limiting factor in increasing the present population, since it is not an annual loss and was much less than the hunting loss, a factor which can be controlled.

Attempts made during the past 18 months to obtain records of deaths of deer from disease have been so unsuccessful that it is felt that the disease problem is negligible at the present time.

Hunting:

The legal hunting take has varied from a low of 63 four or more point bucks in 1933 to slightly over 100 for one year since that time, the 1936 kill was 82.

The fact that the legal kill during the last five years has not shown an increase indicates clearly that the deer herd of Missouri has not been increasing.

The combination of open season and the illegal killing of deer is a decided limiting factor on the deer population. A graphic portrayal of the probable population increase over a period of five years which would result if the usual half-dozen does were not killed as a result of opening the hunting season is shown on Fig. 6. In working out the yearly increase it is assumed that does having their first fawn would only have one, and that after this the twins would average 50%. (Our records for 1936 show the ratio of does with twins to does with one fawn to be 50-50. Townsend and Smith ('33 p. 181) and several other investigators are of the believe that after the first fawn two is the normal number.)

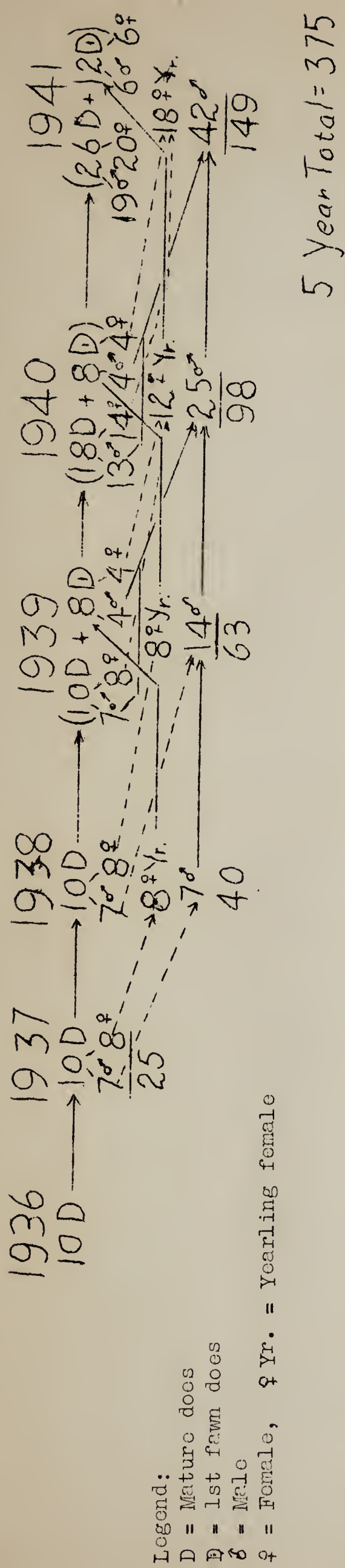


Figure 5a

Possible Population Difference in Five Years from an Annual Loss or Gain of Ten Does.

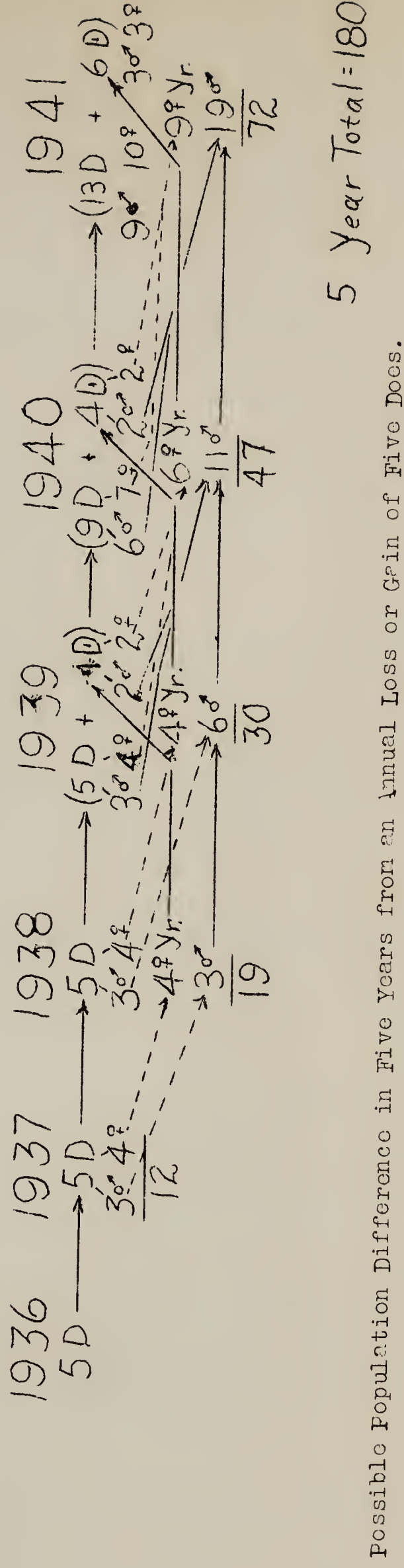


Figure 5b

Thus we see that at the end of five years the possible increase in population would be 180 if the season remained closed and if the average loss by illegal doe killing during the open season is five. If the average illegal doe kill during the hunting season is ten the total possible increase would be 375. The difference of only five in the illegal kill during the hunting season is responsible for a gain or loss of 207 in five years.

These figures show rather conclusively that one of the present large limiting factors is the open hunting season and its accompanying loss of does.

Predators:

The discussion of predators will be divided into two portions (1) out of season shooting and (2) killing by animal predators. Each predator type presents problems distinct from the other.

(1) Out of Season Shooting:

Of the ten records of out of season shooting in range representing 60% of the State, six were does. These figures when extended to the entire deer range for the State indicate an out of season shooting of 17 deer, 10 of which are does. Though any shooting of deer is to be deplored during low deer population, the shooting of does is by far the most serious of the present limiting factors in the deer population at this time.

The importance of the loss of does during the hunting season has previously been shown in the discussion under hunting. Similarly; the loss of does by out of season shooting exerts a very important influence on maintaining the present low deer population.

As shown in figure 5a, the annual loss of ten does over a five year period may be responsible for a decrease of 375 deer, since had these does been allowed to live over this period it is possible that the increase would have amounted to this number (see explanation of figuring increases given under Hunting discussion).

The loss by out of season shooting may be much greater than the records indicate, since, as has been indicated earlier in this paper, the residents of the Ozarks are, as a general rule, very close mouthed about any game law violations. Part of this reticence is due to the fear of revenge by the accused party.

Therefore, we feel justified in estimating the annual loss by out of season shooting to be at least double the number of our records.

The total loss in population due to an annual out of season kill of ten does may amount to 375 in five years. If the out of season kill is 20 does per year this loss may amount to 737. Conversely, if the annual total out of season doe kill is reduced from 20 to 5 the total population increase from this factor may be 557.

The relative increase in total yearly populations as a result of the yearly fawning of the original does and of the doe fawns as they reach maturity is shown by the graph Fig. 9.

In indicating these possible increases no deductions were made for animal predator or disease losses of the deer. As has previously indicated, losses by accidents and disease are at this time negligible in Missouri. Animal predators can be suitably controlled as will be shown. The losses by animal predators, though of importance, do not approach the proportions usually ascribed to them.

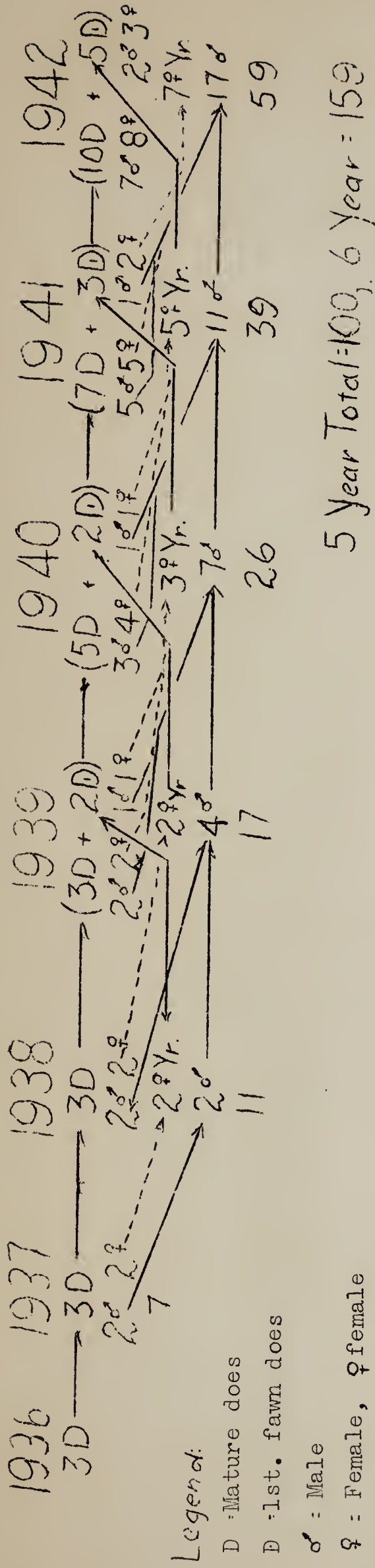
(2) Animal Predators:

The total yearly losses of deer by animal predators of which we have authentic records is 6. Applying this figure to the entire deer range indicates a total loss of 11. Assuming the sex ratio to be 50-50, this gives a doe loss of 5. Over a five-year period, an annual loss of five does may mean a total loss in population of 180. Thus we see that losses by animal predators are important and should receive consideration.

Investigation to date indicates the losses of deer by animal predators to be limited to dogs, wolves and wildcats. Records of the death of one deer by wolves, four by dogs, and one deer either by dogs or wolves indicates dogs to be a more destructive deer predator than wolves. No authentic records of kills by wildcats have been obtained, but preliminary investigations indicate that they may sometimes kill fawns. Much work remains to be done on the problem of animal predators, but enough has been learned to definitely state that the dogs are our most serious animal deer predators at the present time in spite of the increase in wolf and wildcat population in the deer range during the past few years.

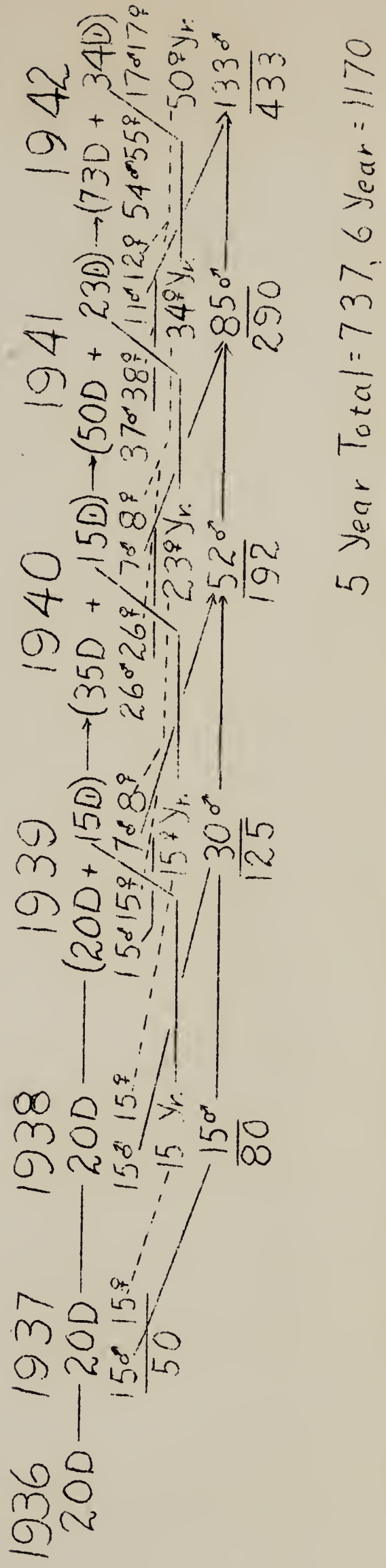
Total doe losses:

Average reported doe loss from hunting	5
" " " " " out of season shooting	10
" " " " " animal predators	6
	<hr/> 21



Possible Total Yearly Differences in Population over a Six year Period, if an Annual Loss of Three Does from Animal Predators was Stopped.

Figure 7



Possible Total Yearly Gain in Deer Population if the Annual Loss of Does was Reduced by Twenty for Six Years.

Figure 8

That the predator losses may be double the reported predator losses is more than likely. If we assume this to be true it can be shown that an annual loss of 35 does from hunting, out of season shooting, and animal predators may cause a difference in population during five years of 1278, Figure 9.

Conclusions based on investigations, and observations of the white-tailed deer in Missouri indicate the following to be the important limiting factors in the present low deer population.

- (1) Out of season doe killing
- (2) Illegal doe killing during open hunting season
- (3) Loss by animal predators, in the order of their importance.

- (a) Dogs
- (b) Wolves
- (c) Wildcat

PART VI

LIFE HISTORY NOTES

In this portion, dealing again with data obtained from direct observation of the experimental animals in the large enclosures, the senior author has attempted to segregate the data into discussions of those phases of the life history on which sufficient information was obtained to warrant reporting at this time.

Bedding Habits:

The location of the bed spot is largely dependent upon and varies with the season and weather.

On bright sunny days in all seasons deer bedded down in the sun on the high slopes with eastern, southeastern or southern exposures. The exception to this practice is that during the hottest days many times the deer bedded down in the grassy meadow. At this time they usually bedded down with at least the head in the shade. However, as the shade moved with the sun, usually the deer did not move immediately. If the day happened to be particularly hot and the sun bright, many times the deer would eventually move again to the shade.

During cloudy weather and during storms there was more variance in the location of their beds as to the type of exposure and nearness to the top of the ridges. During the hot cloudy weather they usually bedded down on the lower slopes at not more than twenty-five feet above the valley floor. At other times in cloudy weather they bedded down on many parts of the slope, but always in a spot away from the wind.

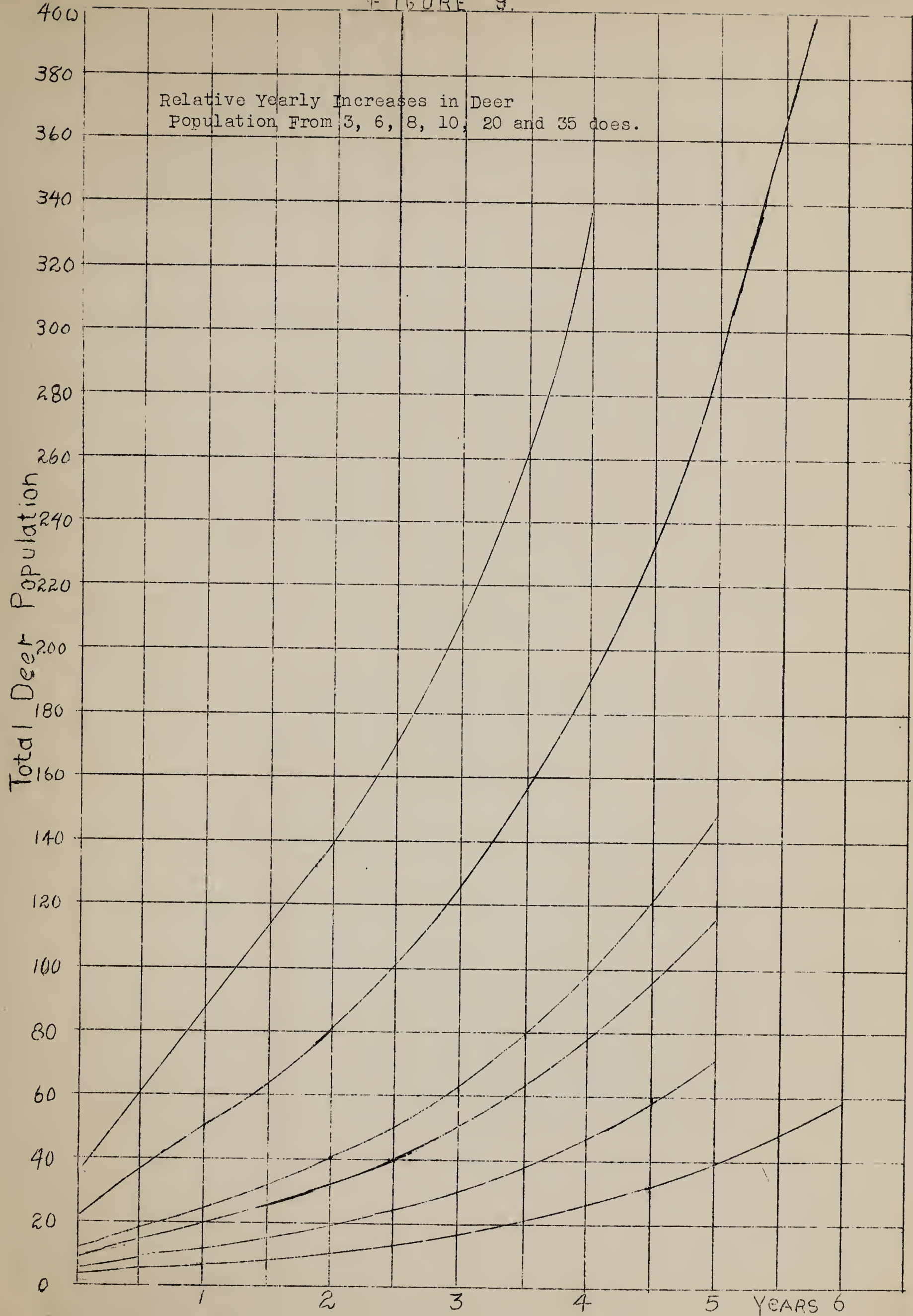
In stormy, windy weather the deer were restless and did not bed down for long at a time. During the more violent electrical storms accompanied by high winds, the deer sought the more open timber at the top of a ridge. Here they browsed rather nervously or bedded down for short periods, after which they would get up, shake the water from their coats, and browse again. At this time their bed spots though near or at the top of the ridge, and in the more open timber, was towards the side of the slope offering the most protection from the wind.

Description of the Bed Spot:

The bed spots, when located on the slopes, were generally in slight depressions which offer a more level spot in which to feed than on the general slope, which is generally rather steep.

The location of the bed spot in the valleys was generally in the grassy-like growth of rushes and sedges growing intermixed on an area that was usually wet except during the hot portion of the summer when there is little rain.

FIGURE 9.



Though the deer often bedded in a rather restricted area during a period extending over several days and sometimes used the same bed spot more than once, these observations indicated this to be one of temporary convenience rather than the deliberate return to the spot as would a rodent to its burrow or a hawk to its perch. These observations substantiate the conclusions of Townsend and Smith '33, "Such spots are distributed widely throughout the home range of the animal. Probably no bed is used more than once."

Daily Rythm:

The normal undisturbed behavior of the deer for each twenty-four hour period was observed to be devoted almost entirely to browsing or resting in the bed spot. However, usually as the deer ceased browsing and were ready to bed down they became more playful. For a few minutes it was the usual procedure for them to pair off and alternately chase each other. Many times the does and bucks paired off together, but as the fall approached, more often a buck and doe paired off. Even at this pre-mating season the bucks chased the does during the play period, but were not chased by the does. Until the last week in October the deer browsed and bedded down as a group, except occasionally one would become separated from the group while browsing and would then exercise alone before bedding down. At such times it would run with great bounding leaps with the tail up and occasionally move slightly from side to side in a zig-zag fashion. At such times, if the deer were browsing in one of the valleys they usually exercised up and down the valley; however, if on the slope, the course was generally in a large circle.

The facility and apparent ease with which the steep slopes were traversed was amazing, their leaps carrying them as much as twenty-five feet at a bound at these times. The period of exercise usually lasted only about five minutes and was the general custom before bedding down. At such times the bucks sometimes omitted a low snort or whistle.

Observations indicated a daily variation in feeding and bedding time. Daily observations over a period of fourteen months indicated a direct correlation between the appearance of the moon and browsing by the deer, and the setting of the moon and the bedding of the deer. In general, our observations showed the deer to be up browsing while the moon was up and bedded down while the moon was down.

Thus with the moon shining during the day the deer would begin feeding at daylight, or as soon as the sun came up. Then usually just before noon they would stop browsing, exercise for a few minutes by running around alone or chasing each other, and then bed down until the middle of the afternoon. At this time they would get up, sometimes browse down to the creek and get a drink or go to browsing without taking water. Browsing would continue until the sun went down. At this time they would usually exercise again and bed down until daylight or sunup.

When the moon begins shining after dark, the deer begin to feed

after dark. At this phase of the moon they browsed until the moon went down and then bedded down until daylight. At daybreak they got up, stretched and browsed for a short time, varying from fifteen minutes to an hour. After a little playful exercise they would bed down again until the moon came up again (during the daytime). With the appearance of the moon they began browsing and continued until late in the afternoon, at which time they bedded down for a short while. Late in the afternoon they would get up, stretch, sometimes browse down to the water, and again continue browsing until the moon set.

In stormy, windy weather the deer are restless and are up and browsing more than usual. Rain without wind does not affect their ordinary routine as much as a high wind. If at rest during the rain they will get up at short intervals, depending upon the intensity of the rain, shake, browse a bit, and lie down again.

The senior author, fortunately, on one occasion closely observed the coat of a deer during a rain which had begun fourteen hours earlier. A thorough examination revealed the hair to be wet only about half way to the skin. An examination of the coat again just after being shaken by the deer revealed that practically all of the moisture had been removed.

Development of the Antlers:

The "buttons" of the antlers began to be evident on the largest buck about the middle of April. At this time the bucks were about twelve months old (see the discussion of approximate ages when received on fawns, Part II). While the antlers were in the velvet stage the bucks were not as active as formerly and observations indicated their movements to be more deliberate and cautious. In addition, there seemed to be a slight loss in vitality until the horns began to harden. The height of the velvet development was reached about September by the largest buck and about one week later by the remaining buck. By September 16, the velvet was about removed from the antlers. At this time the bucks began playful fighting and taking the bark from saplings.

The swelling of the neck seemed to be simultaneous with the loss of the velvet and hardening of the horns. The younger buck, whose antlers began to develop after the bigger buck, lost one horn on December 22, 1936. On December 30, 1936 the remaining antler was still retained after a playful tussel with the larger buck indicating that it was not loose at that time.

Of the three bucks, originally in the first observational area, one escaped and was shot by local residents. The antler development of these bucks for their first set of antlers was six, seven, and eight points respectively. Plate 1 shows the antler development of one of the bucks.

The senior author is of the opinion that the remarkable antler development which was exhibited by all three bucks was the result of greater physiological activity stimulated by a greater quantity of specific enzymes produced as a result of the ideal environmental habitat. The environmental habitat was composed of an abundance of natural foods and water, lack of severe cold and deep snow, and protection from predators.

Mating Season:

First evidences of the beginning of the mating were given on November 1, 1936 when the does began drifting away from the bucks and retreating when approached by the bucks. On November 10, 1936 the does were completely by themselves and the two bucks had separated.

At this time when either of the bucks sighted the larger doe (103) he would chase her. Soon the other buck would appear and the bucks would fight. Usually after a short tussel, one of the bucks would maneuver the other about until he could get the other's neck twisted in towards his body, when this was accomplished he would suddenly shift the position of his antlers to give the other a sharp jab in the side, at which the recipient would turn and flee.

While the fight was in progress this doe (103) would continue her retreat a short distance and resume browsing. The victorious buck would again approach the doe, but at sight of him she would again be off on a run. After a few minutes spent in pursuit the victorious buck would give up the chase and begin browsing.

At this time (November 10, 1936) the younger doe would retreat at the sight of the bucks, but was not pursued by them. Apparently this doe (104) had not reached sexual maturity and its accompanying estral cycle at this time. The exact date of the breeding of the younger fawn was not ascertained. The last evidences of freshly barked saplings were seen during the first week in December. During this week the males and females were seen browsing together for the first time since November 10, 1935.

On November 12, 1936, mating of doe 103 and buck 105 occurred.

Thus we found that the mating season for the two doe under observation extended from November 12, until some time in the first week of December; a period of time extending over 20 to 25 days.

These two doe were born, as previously stated, during the spring of 1935 in the same part of Minnesota.

Because of the limited number of females under observation it seems logical to conclude that the extremes of the late fawns and early fawns were not represented. An examination of the comparative age estimations of the females, which reached sexual maturity in the period during which observations were made, indicates one to have been a late

fawn and the other about normal.

Several conclusions have been drawn from the results of our observations concerning the length of the mating season. They are listed as follows:

- (1) That there is some correlation between the length of the mating season and the length of the fawning season.
- (2) That if an early female fawn had been included with the late female fawn under observation the mating period would have resulted in the mating extending over a period longer than 25 days with a normal sex ratio.
- (3) That under conditions of environment offered by an ideal habitat, sexual maturity of female deer is reached at an age from seventeen to eighteen months.
- (4) That sexual maturity of male deer is reached at an age of 16 to 17 months, and for this reason, the sexual urge of males is received prior to that of the females.
- (5) That a 50-50 sex ratio is not necessary to make it possible for all females to be bred as soon as they receive the sexual urge. Just how low this ratio can fall and continue to make this possible is a matter of speculation, however, observations to date indicate that this ratio would fall as low as 35-65.
- (6) That when deer populations are of such size that it is good management practice to remove a number of males, the hunting season should be opened after the mating season is nearly complete. This should not be before Thanksgiving in Missouri.

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